

# **Mapping Moorea's Lagoon: Conflicts over Marine Protected Areas in French Polynesia**

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## **Abstract**

This article examines the process of establishing a series of marine protected areas (MPAs) in the lagoon around Moorea, French Polynesia from 1998 to 2001. This case study is set within the context of tourism development resulting from the end of French nuclear testing and its concomitant incomes and social subsidies. Theoretically, I engage the approach of political ecology to explore the relationships between capitalist economic restructuring; environmental decision-making, and politics over lagoon knowledge and resources. My analysis raises questions about the objectivity of Geographic Information Systems and MPA science, as well as assumptions that local control and public participation are always effective in environmental decision-making.

## Introduction

Following a recent trend in national and international marine conservation policy, the Territory of French Polynesia embarked on a process to designate a system of marine protected areas (MPAs) in the lagoon surrounding the island of Moorea in the spring of 1998.<sup>1</sup> Globally, MPAs have become a popular form of marine resource management in the last ten years (Kelleher et al., 1995; Agardy, 1997), and increasingly MPA policy-makers are using digital mapping techniques and Geographic Information Systems/Science (GIS) to illustrate and analyze data, and make management decisions (Stanbury and Starr, 1999; CDFG and NOAA's CINMS, 2001; Living Oceans Society, 2001). Several MPAs have been effective in the management and conservation of marine habitats in general, and some fisheries in particular (Halpern, forthcoming). Likewise, GIS has been successfully used to support various environmental decision-making and management processes (O'Looney, 1997; Malczewski, 1999; Bojorquez-Tapia et al., 2001; Jankowski and Nyerges, 2001). On the contrary, I argue that the combination of state-mandated MPAs and GIS has fostered political struggles and organized resistance among stakeholders<sup>2</sup> unlike any previous resource regulations in French Polynesia. These political struggles might ultimately render MPA management plans unsustainable due to the absence of key stakeholder participation and cooperation.

While there has been a recent explosion of natural science and policy publications on various dimensions of MPAs (for a review see Halpern, forthcoming), studies on the social dimensions of MPAs are sorely lacking (Suman et al., 1999; Elliot et al., 2001). Terrestrial resources, especially forests, have been sites of mapping and conflict since at least the emergence of the European states (Kain and Baigent, 1992). In contrast, the ocean has been largely considered a one-dimensional and empty space, mapped only to aid in the navigation from one land to another (Steinberg, 2001). The cartography of what lies below the surface of the ocean is lately becoming more visible due to the fusion of two trends. First, the scarcity of marine resources and the pollution of the marine environment have become issues of worldwide concern in the last decade (Vallega, 2001). Second, this concern is being fed by the tourism and leisure industries as coastal and marine environments become increasingly popular destinations for middle and upper classes in both the "First" and "Third Worlds" (Lencek, 1998).

The fieldwork for this project was carried out in Moorea in the summer and fall of 1999, and the summer of 2001. Interviews were conducted with members from lagoon stakeholder groups, including fifteen fishers, seven lagoon tour operators, six hotel managers, four leaders of fisher/environmental associations, and eight personnel from the various agencies involved in the MPA designation process. I also attended several MPA decision-making meetings, and

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<sup>1</sup> The term "marine protected area" or "MPA" (aire marine protégée or AMP in French) was one of many terms used by participants in the process of creating MPAs in Moorea. I am using this term throughout this paper because it is the standard international term for "no-take" marine management zones (see Salm et al., 2000).

<sup>2</sup> I use the term "stakeholder" as opposed to the term "user" in order to include in this analysis actors who use the lagoon in non-extractive or non-economic ways, or who feel they have a right to participate in lagoon management. For a review of the concept of stakeholders in environmental management in general, and fisheries management particular, see Grimble and Wellard, 1997; de Lopez, 2001; Mikalsen and Jentoft, 2001.

fisher/environmental association meetings. Finally, I conducted participant observation by accompanying fishers and lagoon tours on lagoon excursions. The paper is organized into four parts: First I shall examine the political ecology of tourism development in Moorea. Second, I shall explain the process of mapping MPAs in Moorea contextualized within the recent debates in geography over the politics of mapping and GIS. Third, I shall explain how the process of mapping MPAs in Moorea has precipitated conflicts over lagoon space and lagoon knowledge, and has provoked resistance to state conservation interventions. Finally, I will conclude by examining the ways in which this case study problematizes theories about how public participation promotes environmental sustainability.

### **The Political Ecology of Tourism Development in Moorea**

My inquiry into the relationships between resource mapping, GIS, and environmental decision-making is situated within the theoretical approach of political ecology. This field has emerged in the last decade or so as a political economy approach to human-environment relationships, particularly in regard to environmental conservation and degradation. In this approach, the environmental use, access, and control of individual resource users is emphasized, within the context of local, national, and international political and economic influences, in addition to local and regional histories (Blaikie and Brookfield, 1987; Bryant and Bailey, 1997; Vayda and Walters, 1999). It is assumed that resource degradation is both a cause and a result of poverty – or the social relations of production – as opposed to theories which suggest that population pressure or peasant mismanagement alone are to blame (Hardin, 1968; Homer-Dixon, 1994). In addition, political ecology is concerned with links between the environment, resistance and social movements, or what Peet and Watts (1996) call “liberation ecology” (see also Shiva, 1989; Sachs, 1993; Escobar, 1995; Stonich and Bailey, 2000; Peluso and Watts, 2001). In addressing politics, these studies examine not only struggles over material resources, but struggles over the meanings and representations of resources (Carney and Watts, 1990; Peluso, 1992; Rangan, 1996). This study builds upon the growing collection of political ecology analyses of marine resources (Nichols, 1995; Stonich, 1995; McGuire, 1998; Walker, 2001; Young 2001), as well as political ecology analyses of island and coastal tourism development (Stonich, 1998; Trist, 1999, Young 1999).<sup>3</sup>

The island of Moorea is located in the center of the Pacific Ocean in the Society Islands, among the five archipelagos (118 islands and atolls) which constitute French Polynesia (see Figure 1). Moorea lies sixteen km northwest of the island of Tahiti, home to French Polynesia’s capital, Papeete. It has a land area of 12,520 hectares, 61 km of coastline, and a population of over 12,000. Moorea is encircled by a barrier reef which forms a 30 square km lagoon ranging from 500 to 1500 meters in width. The reef has twelve passes which correspond to the principal valleys on the island (Galzin and Pointier, 1985).

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<sup>3</sup> There are a great many publications which address either the political economy of tourism, or the effects of tourism on the environment, which shall not be reviewed here (see Stonich, 1998:30 and Hunter and Green, 1995 for reviews).

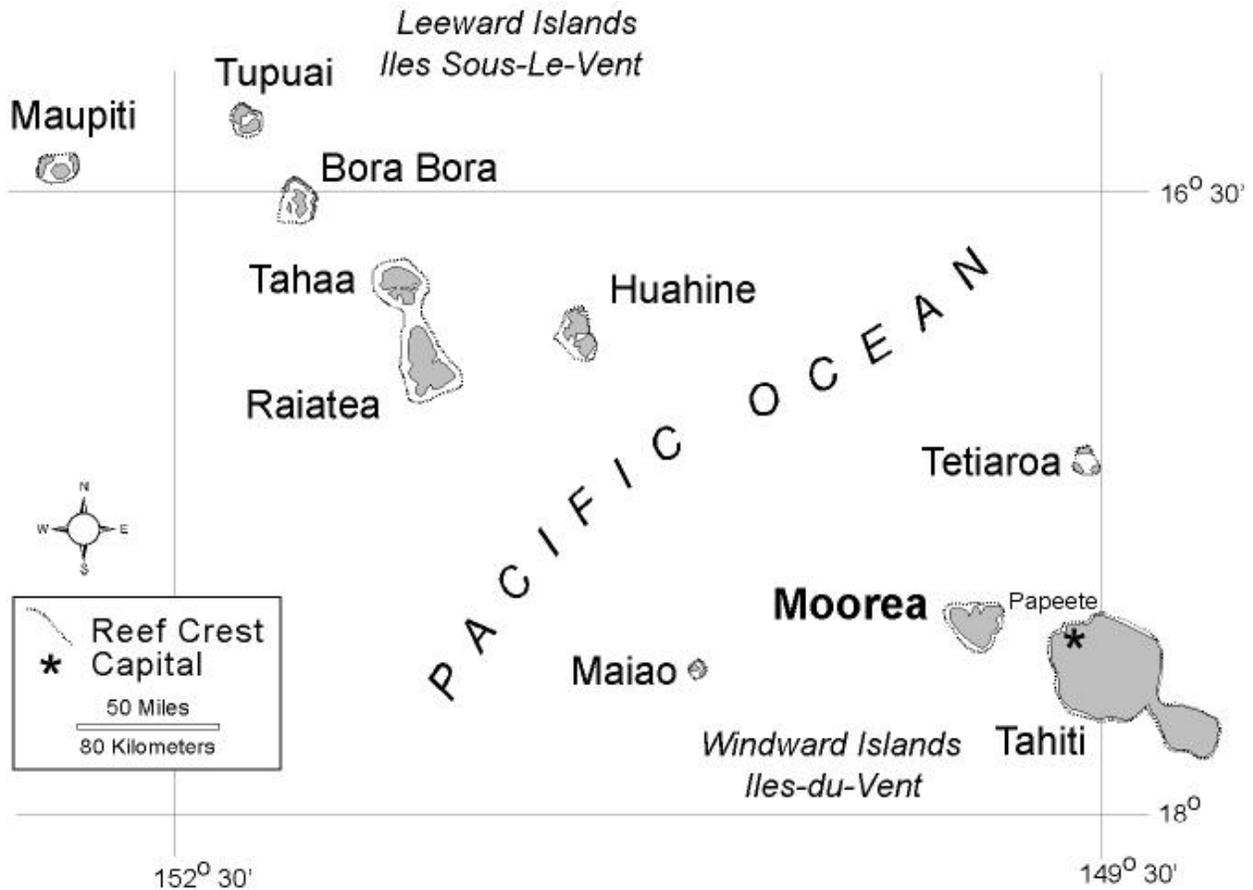


Figure 1. The Society Islands

French naval officers first decreed protectorates over Tahiti and Moorea in 1843. *Polynésie Française* was established in 1957, and remains a French Territory to this day. Prior to the 1960s, French Polynesia had traded precariously on international markets with meager exports of copra, vanilla, coffee, and phosphate. In the early 1960s, the copra and vanilla markets slumped, while the phosphate reserves on Makatea were nearly exhausted (Thompson and Adloff, 1971). After Algeria gained its independence in 1962, France shifted its nuclear test program from the Saharan Desert to French Polynesia, which marked a surge in economic development in French Polynesia, particularly in the Society Islands. An airport and shipping ports were built at Papeete on reclaimed reefs to handle the transfer of people and equipment for the nuclear test sites on the atolls of Moruroa and Fangataufa, as well as a support base on Hao Atoll and the headquarters in Papeete. The construction of this infrastructure also opened the gates for tourism to enter the region (Henningham, 1992).

The structure of French Polynesia's economy was altered dramatically over the following decade. In 1960, military spending in the area constituted 4 percent of Gross Domestic Product (GDP). By 1966, this figure rose to 76 percent, and leveled out in the 1970s at around 30 percent. Similarly, France's social spending increased to the equivalent of approximately 30

percent of GDP, increasing in the 70s to compensate for the downturn in military spending (Blanchet, 1985:128). The bomb economy encouraged migration to the island of Tahiti, where by 1992, over 70 percent of French Polynesia's population resided (Henningham, 1992:130). Because of its proximity to Tahiti, Moorea was utterly transformed by the atomic economy. As a majority of adults left subsistence activities to participate in the cash economy, the production of local food supplies declined sharply (Robineau, 1984). Small-scale, local agriculture was the dominant economic sector in the history of Moorea, and is increasingly being replaced by expanding tourism and service sectors, in addition to concentrated export-agricultural operations, such as pineapple plantations. By 1990, French Polynesia imported over 80 percent of its food (ADPAEPF, 1989).

### *Le Pact de Progres*

While many South Pacific island nations are considered part of the Third World, French Polynesia's economy has been maintained by France at an artificially high level, such that the per capita GDP is around US\$ 16,000. Civil and military transfer payments from France are the basis of French Polynesia's modern economy. These payments – which are disbursed through public sector jobs and well-subsidized social services – along with steep import taxes, have kept both the standard and cost of living high (Osman, 1996:16). In 1993, the government of French Polynesia launched *Le Pact de Progres* (The Pact of Progress), a ten-year economic development plan which aims to achieve local economic self-sufficiency based on tourism, agriculture, and fishing. It is speculated that in 2006 France will begin the process of withdrawing the massive subsidies and metropolitan transfers which were necessary to maintain local acquiescence to the 179 nuclear detonations at Moruroa Atoll between 1966 and 1995 (CDPESC, 1995:6, Osman, 1996:9). Between 1993 and 2003 the local economy will need to grow by 7 per cent annually in order to meet the goals of *Le Pact de Progres*, in which local industries are expected to contribute US\$ 650 million, or 43 per cent of the projected US\$ 4 billion GNP. Although military transfers shall decrease by half between 1996 and 2003, France has committed to incrementally increasing civil transfers from \$US 430 million to approximately US\$ 680 million until 2006 when the transition to a self-reliant economy is expected to take place (see Figure 2).

Development projects and contracts undertaken through *Le Pact de Progres* on Moorea are largely related to tourism. These include the construction of a new 150-room resort hotel, improvements and additions to existing hotels, and loans to tour companies for the purchase of new vehicles and boats for increasing numbers of tourists (particularly from two 700 passenger cruise ships which began touring the Society Islands in July 1999, bringing over 47,000 tourists per year<sup>4</sup>). A government internet site lists other projects waiting for tax-free foreign investments, such as two eighteen-hole golf courses and three hotels on government lands which are currently forested and/or under government protection from development ([www.tahiti-invest.com](http://www.tahiti-invest.com)). The number of tourists to visit French Polynesia has almost doubled in the last decade, increasing from 132,361 in 1990, to 233,326 in 2000, approximately 80% of whom visit Moorea (ITSTAT, 1998; STT, 2001). The Territory aims to attract 620,000 visitors by 2012.

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<sup>4</sup> At the time of this writing, the cruise ship company had recently gone bankrupt and ceased operations in the aftermath of the September 11 terrorist attacks in the United States. It is not known when or if the company will resume operations.

There are 30 hotels and pensions on Moorea, with a capacity for 1,103 guests (STT, 2001). The cost of living in French Polynesia has risen dramatically as property values are driven up by outsiders purchasing land for new businesses and vacation or retirement homes, and because growth is limited by the small size of the island. As Moorea has increasingly become a suburb of Tahiti, accessible by ferry services, the population of Moorea has grown by over 58% since 1980, excluding tourists.

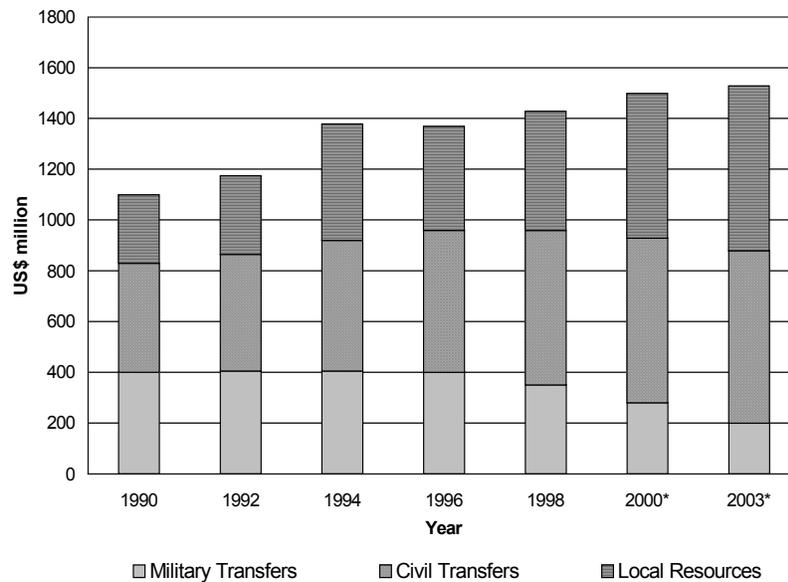


Figure 2. Goals of Le Pact de Progres

### Mapping Moorea’s MPAs

Despite the presumably significant impacts of land-based pollution from urban, suburban, and agricultural development on Moorea’s lagoon (Porcher and Gabrie, 1987; Gabrie et al., 1988; Aubanel, 1993), fishing was the only impact under consideration for regulation in the MPA decision-making process. A joint governmental committee, called the *Commission de l’Espace Maritime* (Marine Space Commission or CLEM) led the process of designating the MPAs or what was officially called the *Plan de Gestion de l’Espace Maritime* (Marine Space Management Plan or PGEM).<sup>5</sup> The Ministry of the Sea funded the PGEM initiative with a French development contract totaling 15 million French francs (approximately US\$ 2 million), and they are currently applying for more funds to complete the process on Moorea and to create MPAs at other islands. This funding covered the costs of organizing and attending meetings, salaries for ministry employees and cartographic and environmental consultants, in addition to the documents and maps which have been produced throughout the process. It was originally

<sup>5</sup> The committee included representatives from the federal Ministries of the Sea, Urbanism, and Tourism/ Environment.

thought that the process would only take six months, but it was not completed until November, 2001.

The idea of designating MPAs in Moorea's lagoon was conceived by the members of the territorial government and Moorea's local government, in response to a recommendation by a Pacific Asia Travel Association Task Force (PATA, 1991), as well as their perception of overfishing<sup>6</sup> which was largely thought to stem from increased population pressure. The PGEM is an extension of laws passed in 1996 which give the Territory rights to manage marine resources. Many lagoon stakeholders from Moorea view the PGEM as part of the government's over-arching tourism development plan rather than a conservation measure. They feel that MPAs are being implemented in the interest of tourists, and that the government is attempting to drive fishers and local people out of the lagoon. To support this claim, they cite evidence that the MPAs are only being planned for Moorea and Bora Bora, which are the two most visited islands by tourists, despite the fact that other islands – particularly Tahiti – have the same or worse overfishing and lagoon environmental problems. It also seems suspicious to many fishers that tourism and the environment were consolidated into one ministry in 2000.

Public participation was considered necessary by the CLEM to insure the sustainability of the MPAs. The CLEM designated four user-groups – fishers, lagoon tour operators, hotels, and Moorea's local government – and representatives were selected for each. Marine biologists and ecologists were included as advisors to the process. Public participation was very low in the beginning of the process, but increased in late 1999. Yet even by mid- 2001, many people on Moorea had never heard of the PGEM. Fishers and hoteliers, in particular, were largely absent from the meetings. Reasons given for not participating included: meetings were held at inconvenient times of the day while stakeholders were at work; meetings were held too far away (until 2001 meetings were only convened at the Mayor's office in Afareaitu which is the town closest to the Tahiti ferry terminal); a lack of trust for the French and for the government; and the suspicion that participation in the meetings would be understood as complicity in creating MPAs. Since the beginning of the process, a Tahitian fisher on Moorea attended every meeting and volunteered to translate from French to Tahitian and vice versa for fishers and for the French policy-makers. Eventually he was hired by the Ministry of the Sea to act as a translator and liaison to the fishers of Moorea, and it was he who persuaded the planning team to convene meetings in each commune on the island, and to hold their meetings at more convenient times, such as in the evenings and on weekends.

A series of computer-generated maps were central in the politicization of the PGEM decision-making process. A database of lagoon information was created by the Ministry of Urbanism, using the CAD program Bentley MicroStation, which included a base map of the island and its reef crest, and data on the following lagoon uses and features: hotels (many of which have over-water bungalows built into the lagoon) and adjacent swimming areas, fishing, lagoon tour activities (shark feeding, ray feeding, scuba diving, dolphin and whale sighting), and

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<sup>6</sup> I use the term perception because there have been no studies which quantify Moorea's fishstocks or patterns of fisheries decline. However, observations among marine scientists and a variety of people from Moorea who have witnessed changes in Moorea's fishstocks and those of other islands in French Polynesia indicate that the size and number of Moorea's lagoon fish have declined in the past several decades.

permanent features of the lagoon (piers, channel markers, and the general outlines of reef areas). The maps produced by the government seemed “scientific” and “official,” making them difficult to refute by stakeholders. Yet many of the data layers were based on inadequate data. For instance, the data on fishing areas were collected in one day by a person who drove around the island and noted the location of canoes in the lagoon that could be seen from the road; none of the data layers included measurements of lagoon use in terms of temporal or economic value; and no data were available on lagoon substrates or habitats which would have been helpful in siting the MPAs in relation to variations in lagoon ecology and use.

The use of these maps in the PGEM decision-making meetings limited the ability of many stakeholders to insert their cognition of the marine environment into the maps or the decision-making process. In addition, stakeholders felt that important uses and meanings of the lagoon – such as the non-economic value and the spiritual meanings associated with certain areas – could not be identified, quantified, or mapped within the confines of a digital database, or on an analog map for that matter. Stakeholders voiced anger and frustration at not having access to, or knowledge of the computer mapping technology used. At the same time, stakeholders were reluctant to provide their own data to the PGEM policy-makers because they did not trust the state to input or analyze their marine knowledge fairly in the GIS.

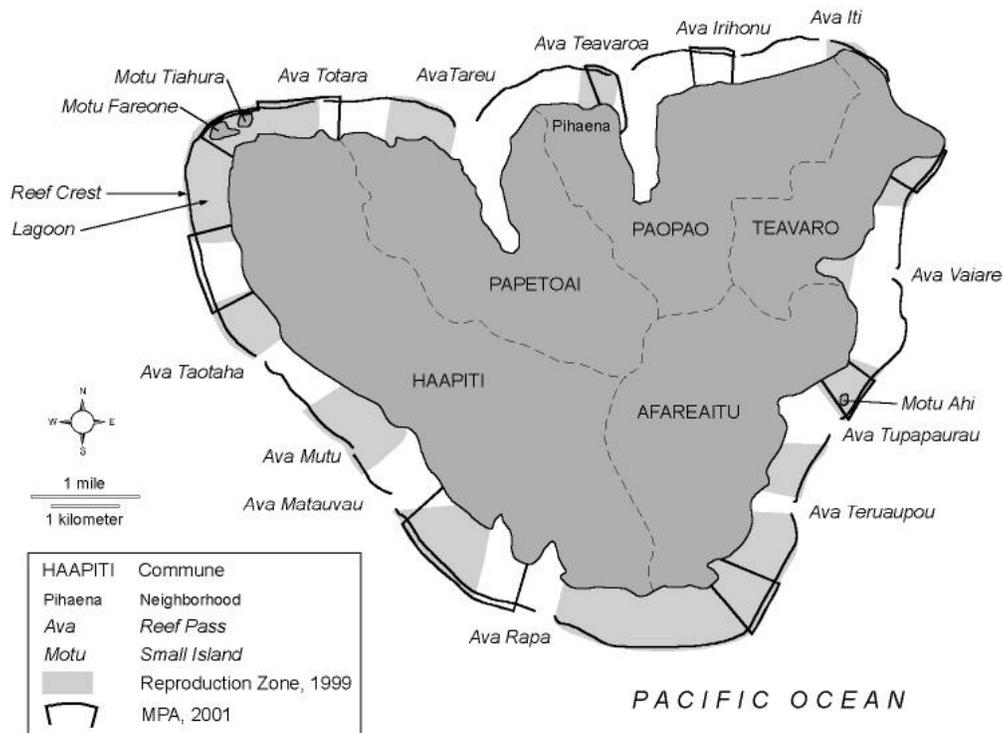


Figure 3. The Evolution of Moorea’s MPAs

The first PGEM map was published in a daily newspaper in September 1999, which

depicted the lagoon's fish reproduction zones (*zones fertiles*) as mapped by a French marine biologist and a local petty commercial fisher from Moorea's north shore (see Figure 3). The map designated over 50% of the lagoon as reproduction zones, and many citizens of Moorea assumed that this was the government's MPA plan. The Ministry of Urbanism claims that this map was never intended to be published, and that they never planned to zone this much of the lagoon. However, a fisheries extension agent of the Ministry of the Sea proceeded to advertise this map to fishers on Moorea as the final MPA plan, in which fishing would be henceforth forbidden in the reproduction zones. The publication of this map set the stage for the conflicts and struggles which were to follow over the next several months.

Theoretically, these conflicts can be situated among studies on the politics of mapping (for example Harley, 1988; Monmonier, 1991; Buisseret, 1992; Kain and Baigent, 1992; Wood, 1992; Gregory, 1994). The majority of these studies address state hegemony in the history of mapping resources and empire in Europe and North America, arguing that maps are sources of power for the powerful (Nobles, 1993; Escolar, 1997; Craib, 2000; Appuhn, 2000). Fewer of these studies have focused on either "Third World" cases (Bassett, 1994; Neumann, 1996; Moore, 1998), and/or more recent histories (Aberely, 1993; Peluso, 1995; Berg and Kearns, 1996; Sieber, 2000a). Related to this literature is the debate in geography over quantitative versus qualitative methods, recently surrounding the use of GIS in particular (Golledge et al., 1988; Openshaw, 1991; Smith, 1992; Dixon and Jones, 1998; Clark, 1998; Dorling, 1998; Schuurman, 2000). As with the wider literature on the politics of mapping, questions have been raised about the politics of access to GIS technology, such as who constitutes the data, and for whom the data is analyzed and used (Lake, 1993; Obermeyer, 1995; Pickles, 1995; Sheppard, 1995; Towers, 1997; Warf, 2001). Others are critical of the military and corporate origins of GIS and its surveillant nature (Pickles, 1991; Goss, 1995; Curry, 1998). Still others question the ability of GIS to accommodate multiple epistemologies in terms of assumptions about space and science, representations of the world, and the privileging of certain forms of knowledge (Aitken and Michael, 1995, Curry, 1994, Rundstrom, 1995). As a result, the phrase "public participation GIS," or PPGIS, was created to define research which is concerned with all voices being heard in a democratic GIS (Craig et al., 1998). While the majority of this literature investigates the political power of the state and other hegemonic institutions, fewer studies examine the politics of the subjects of map making and GIS; particularly how "subaltern" groups produce "counter-maps" (Nietschmann, 1995; Peluso, 1995; Moore, 1998; Craig and Ellwood, 1998; Sieber, 2000b). This project brings a new perspective to this literature by examining how resource maps and map-making incite not only the production of "counter-maps," but the mobilization of resistance by formerly unorganized stakeholder groups.

### **Conflicts over Lagoon Management, Knowledge and Access**

The process of mapping MPAs in Moorea has exacerbated existing conflicts between and among stakeholder groups, and at the same time has incited well-organized anti-state resistance by newly-formed fisher/environmental associations, unlike any previous marine or fisheries regulations. In particular, the mapping of MPAs in Moorea highlighted three types of conflict: a) conflicts over modern vs. traditional forms of lagoon conservation, b) conflicts over policy-makers'/scientists' knowledge vs. fishers'/locals' knowledge about the lagoon environment and ecology, and c) conflicts over access to lagoon space and resources.

### *Competing Conceptions of Protected Areas*

The definition of an MPA and its enforcement and management were a locus of conflict in the PGEM process. The protected areas in question have been named and defined in various ways since the beginning of the process. Different terms included: reproduction zone, reserve zone, protected zone, regulated zone, *rahui* zone, marine protected area, and intermediate zone (*zone fertiles, zone réservée, zone protégée, zone réglementée, zone rahui, aire marine protégée, and zone intermédiaire*). At the same time, there was little agreement among the various stakeholders and policy-makers over what any of these terms mean. In the beginning of the process, the government intended the zones to be fully protected, in which no extractive activities would be allowed. In the PGEM meetings, the zones were alternately called reserve zones or protected zones, while the term marine protected areas was most often used only among policy-makers. When the publication of the map of reproduction zones (Figure 3) in 1999 created such controversy and resistance among Moorea's lagoon stakeholders, the PGEM policy-makers were forced to back-down from their ideal designation of the zones. By mid-2001, stakeholders were encouraged to map and define the location and management of the zones themselves, even if they did not fit the original criteria. At a series of meetings with fisher/environmental associations around the island, new zones were sited and defined (see Figure 3). Many of these associations moved zones and designed smaller zones called regulated zones, in which they would allow low-impact types of fishing to continue (such as with a line or small net), while fishing with large nets, and spear fishing at night with lights would be forbidden. In addition, the associations pressed for zones in which certain tourism activities such as speed boats would be restricted, called intermediate zones. However, the associations were skeptical that the PGEM policy-makers would enact their recommendations in the final map.

Related to these disagreements, the traditional concept of a *rahui* and other types of lagoon management policies in Polynesian culture complicated the definition of the MPAs. Fishers reported that they maintain adherence to generally agreed upon fishing rules among themselves by applying subtle types of social pressure against violators. An often-mentioned customary management regime is the *rahui*, which is a concept used for both terrestrial and marine resources Polynesia. Historically on Moorea, a *rahui* was mandated by local or regional leaders for either accumulation or conservation purposes. The leader of a clan could impose a *rahui* on particular resources in the traditional clan property unit which spanned from the mountain ridge to the shore and out into the lagoon just beyond the reef crest (much like a pie slice of the island). Or a regional leader could impose a *rahui* over an entire island for a particular resource, or over specific areas. A *rahui* is defined both spatially and temporally, and is often rotated from one area to the next in order to allow resources to be extracted and regenerated continuously (Oliver, 1974). The idea of a *rahui* is considered by the PGEM policy-makers to be an historical and inappropriate concept because there are no indigenous social or legal structures which would support this kind of property management today. Land ownership and management in Moorea has been altered dramatically in the last several decades, complicated by the sale of much of Moorea's coastal land to foreign individuals and businesses. Furthermore, French law has rendered all marine and coastal areas public property. Nevertheless, fishers referred to the *rahui* as a viable, appropriate, and legal alternative for marine management in the case of the PGEM. Fishers also made claims to their fishing practices

based on laws established during the reign of King Pomare IV during the late 18<sup>th</sup> century, for instance in which fish traps could be set anywhere on the reef for three days at a time and then moved to another spot.

The replacement of CLEM members and user-group representatives during the process further confused the definition of the protected areas. These changes were accompanied by shifts in definitions and attitudes about MPAs, and styles of public outreach. In addition, territory-wide elections were held in March, 2001, in which the Mayor of Moorea, the Mayors of each of Moorea's five communes, and the councilors of each commune were replaced. The PGEM was an important issue in Moorea's election around which candidates focused their campaigns, and around which constituencies negotiated their votes. The three ministers involved in the PGEM process were also replaced after the presidential election in May 2001.

### *Competing Theories of Lagoon Ecology*

Conflicts also revolved around scientific understandings of Moorea's lagoon ecology and the marine environment. Advice on where to site the MPAs initially came from French marine biologists working at the Centre de Recherches et Observatoire de l'Environnement (CRIOBE) on Moorea. They advised that the MPAs should meet three criteria: a) each should span from the shore to the reef crest in order to include a variety of habitats, b) each should be located next to a reef pass because of the implications for larval transport<sup>7</sup>, and c) the MPAs should be distributed around the island such that each commune would have their share of zones. Many of Moorea's stakeholders resented the imposition of scientific information from foreigners about the lagoon environment, and they questioned the accuracy of the biologists' knowledge. They were also insulted by the lack of respect for fishers' scientific knowledge that was shown by the scientists and bureaucrats. Many of Moorea's fishers keep detailed dairies of fishing information which have been passed down for generations. These dairies include daily explanations of where different species of fish are found in the lagoon, based on a variety of indicators such as currents, winds, the lunar cycle, and seasons. Older fishers, in particular, claim knowledge of their home lagoon areas at the scale of individual coral heads, and they are able to explain precisely where, at what time, and on what day one can go to catch a particular species of fish. Different fishers offer differing explanations of the life cycle of fish, and areas which are most important for reproduction. One important theory of fish reproduction among fishers is that the three "*pointes*" (points: the south, northeast and northwest) of Moorea are significant for reproduction *outside* of the reef crest. With this explanation in mind, many fishers can't understand why MPAs are necessary inside the lagoon at all, but said they would be willing to support the prohibition of fishing at these exterior sites.

Nearly everyone agreed that land-based pollution was part of the problem of lagoon degradation, yet there were differing opinions on how and if regulating it should be integrated

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<sup>7</sup> In Moorea, larvae travels with ocean currents from the lagoon out the reef passes into the open ocean, and then returns via wave action over the reef crest as juvenile fish. It is probable that larvae also travels from island to island, although the spatial circuits of larval dispersal and recruitment patterns of fish to individual coral patches are not completely understood by biologists and ecologists working in this area (Dufour and Galzin, 1993; Planes et al., 1993).

into the PGEM. Fishers and lagoon tour operators consistently blamed the poor health of the fisheries and the coral reef on sediment and pesticide run-off from agriculture and sewage effluents from hotels, rather than overfishing. They demanded that farmers and hotels be regulated in the PGEM as well. However, farmers were never invited to participate in the process, and hotels claimed that their sewage systems were in proper working order.<sup>8</sup> The CLEM said that they could not consider land-related activities in the PGEM because these are governed by a separate plan and process called the *Plan General d'Amenagement* (Forestry Plan) under the Ministry of Urbanism.

### *Conflicts Over Lagoon Space*

The mapping of MPAs precipitated various forms of conflicts among and between different stakeholder groups and the state. These conflicts ranged from verbal disputes to violent confrontations to large-scale protests. To begin with, the PGEM exacerbated conflicts which existed between fishers over access to lagoon areas and resources. After the map of reproduction zones was published in 1999, lines were immediately drawn between fishers who lived adjacent to the zones, and fishers who lived adjacent to the open areas. People suspected that various kinds of political and economic corruption were exercised in the drawing of the reproduction zones. In one instance, the commercial fisher who had participated in the map-making became a victim of arson. Within two weeks of the map's publication, his boat and most of his nets were burned. This was not surprising to anyone because it was not lost on the fishing community that there had been no reproduction zones designated in this fishers' main fishing areas on the northeast shore of the island. In addition, this fisher's equipment had been vandalized in the past in relation to accusations against him of unsustainable fishing practices.

In another instance, fishers from two different villages came to blows over access to a seasonal fishing area on Moorea's east shore. From October to January, a migrating species called *ature* or *aramea* depending on their size (*Selar crumenophthalmus*) appears in the deep bays of several of the Society Islands. Until recently, these fish were harvested cooperatively by groups of fishers from different communities, using a large canoe and net which are made especially for *ature* fishing. In 1998, shortly after the PGEM began, petty commercial fishers from the north shore attempted to set an *ature* net in a bay on the east shore. They were met by east shore fishers who paddled out into the lagoon and attempted to beat them and take their fishing gear. Fighting between the same fishers and their families also occurred on shore in the following days, and the east shore fishers established a community association which would restrict and monitor the types of fishing allowed in their home lagoon. Confrontations over *ature* fishing in this bay have occurred each year since 1998, and in early 2001 policy-makers had mapped zones specifically for *ature* fishing in the PGEM.

Second, sharkfeeding has become a controversial aspect of the PGEM process, which has pitted fishers and hotel managers against lagoon tour operators. There are seven tour operators (most of whom are Tahitian) who conduct shark and ray feeding tours in the lagoon of Moorea.

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<sup>8</sup> French Polynesia's Ministry of Hygiene reports unsafe water quality at several swimming areas adjacent to large hotels on Moorea, due to high counts of fecal coliform (MSRDS, 1998).

At various places in the lagoon, these tour boats drop anchor and clients are invited to line up in the lagoon behind a thin rope. On the other side of the rope, less than ten feet away, the tour guides either wave a large fish carcass in the water, or throw small pieces of fish into the water. In a matter of seconds, several black-tipped reef sharks which range in size from two to five feet swim into the area and attack the fish carcass or eat the individual pieces of bait. Tour operators contend that there has never been a single incident of a shark attacking a human in the fifteen years that these tours have been conducted. Prior to the PGEM process, there was no controversy over these tours, and it was not reported that fishers or hotels were opposed to them. In fact, many of Moorea's hotel and tourism brochures advertise shark-feeding as a unique tour that cannot be experienced anywhere else in the world. Perhaps in attempting to shift the aura of culpability in the process away from themselves, both fishers and hotels suddenly became concerned about the safety of these tours, and began to worry that sharks might attack humans. Fishers complained that sharks had recently become a dangerous nuisance during fishing excursions because they swim close to fishers and try to steal bait or harvested fish. It was also reported by fishers that sharks are larger and more abundant in the lagoon than ever before, and that sharks are no longer afraid of humans. There are several hotels which are adjacent to shark feeding areas in the lagoon and hotel managers fear that sharks will swim into hotel swimming areas and attack their clients. These conflicts consisted only of verbal arguments during the PGEM meetings, but the tour operators formed a federation and began preparing to take legal action if their activities were curtailed in the final PGEM plan. Various alternatives were considered which ranged from moving shark-feeding outside the lagoon, reducing shark-feeding to one location, or banning shark-feeding altogether, although none have been enacted.

Finally, a series of conflicts occurred between fishers and hotels. Prior to the PGEM process, most of the large hotels attempted to restrict fishing access to the lagoon areas adjacent to their property – particularly around overwater bungalows, which extend up to 300 meters out in the lagoon. Several fishers relate incidents in which hotel security guards and managers have yelled at them from shore to leave the area, and have threatened to call the gendarmes to arrest them. Hotels claim that they have legal rights to restrict access to these areas because they pay rent to the government for marine concessions. In January of 2000, this conflict was heightened while a new luxury hotel was being built on the north shore in the Pihaena neighborhood. A dredge appeared in the lagoon which began scooping sand from an inshore area, and depositing it adjacent to the new hotel. The destruction of the reef for this artificial tourist beach was infuriating to residents of Pihaena, particularly in light of the PGEM process which would restrict their access to the lagoon for allegedly environmental reasons. Fishers and their families from the area immediately organized themselves and consulted an environmental organization called *Faatura Aimeo* (Respect Moorea) which was founded in Moorea over 10 years ago by European ex-patriate residents in order to educate local people about problems related to throwing trash in the lagoon. *Faatura Aimeo* hired a lawyer who advised the people of Pihaena to create a human barrier around the dredge to prevent the removal of any more sand while he prepared the case. Thus in February, fishers encircled the dredge with outrigger canoes and continuously occupied the canoes. A camp was erected on shore where Pihaena families and others spent their days talking, preparing food, and passing the time as they rotated in and out of the canoes. A large sign was placed next to the road which invited passers-by to join the fight for Moorea's environment and a petition against the sand removal was circulated and signed by over 2500 people. Pihaena then sent a delegation of over fifty people to Papeete to present the

petition to the president and the French High Commissioner. During this lengthy protest, alliances were formed among a variety of individuals and groups, including fishers, farmers, sovereignty movement members, and environmentalists.

The on-going PGEM meetings during this time were rife with heated discussions about the stand-off, and the process of mapping the MPAs was put on hold. The lawyer discovered that the hotel had ignored all of the territorial laws which regulate the removal of sand and almost three months later on April 5, the High Commissioner ordered the departure of the dredge from the lagoon. Since then, six different neighborhoods/villages from around Moorea have formed fisher and/or environmental associations to create localized marine and land management guidelines, and attempts are being made to form a federation which includes all of the associations on the island. These associations are composed entirely of *Maohi* (Society Islander) people, and their agendas revolve around conserving the lagoon for local subsistence fishing (as opposed to fishers from other islands and commercial fishing), restricting tourism development (especially the building and expansion of coastal hotels, and shark feeding tours), providing lagoon and fishing-related education for Moorea's youth, providing fishing canoes and gear for poor families, and making their voices heard in the government's lagoon and terrestrial management policies.

### **Discussion: Public Participation and the Politics of Place**

There is an increasing assumption in the fields of environmental conservation research and policy that local control and public participation are always good for the environment (West and Brechin, 1991; Wells and Brandon, 1992; Western and Wright, 1994; Cultural Survival Quarterly, 1996). It is argued that local, public participation ensures environmental and economic sustainability in rural communities (Budd-Falen, 1995; Jentoft, 1999), and that the traditional environmental knowledge of local resource users is detailed and relevant to modern conservation objectives (Brokensha et al., 1980; Berkes et al., 1989; Durrenberger, 1990; Croll and Parkin, 1992; Johannes, 1994; Agrawal, 1995; Berkes, 1999; Fischer, 2000). Studies of common property systems in particular have documented the ways in which outside interventions disrupt sustainable forms of local environmental management, and public participation is paramount among the many descriptions of successful CPR "design principles" (Ostrom, 1986, 1990, 1995; Acheson and McCay, 1987; Berkes, 1989; Feeny et al., 1990; Dyer and McGoodwin, 1994; Ostrom et al., 1999).

This case study in Moorea raises questions about the assumed connections between local control, public participation, and successful conservation results. The above narrative illustrates that Moorea's fisheries were being degraded under local control, prior to the government's PGEM intervention which began in 1998. Although fishers loosely adhered to customary fishing codes and punished transgressors among themselves, it is likely that they were overfishing nonetheless. Moreover, they did not have control over non-lagoon sources of pollution, such as sewage and agricultural effluents, which they believe are the main sources of degradation. This points to the complexity of the history of resource use in Moorea, and the interconnected political and economic pressures which have shaped resource use and abuse. It appears that the lagoon and its resources are embedded in a much wider social and ecological system in which

local control is not possible, and has not been possible since at the least 1962 when France began developing the infrastructure for nuclear testing which spurred Moorea's tourism economy.

Likewise, this case study problematizes the virtues of public participation in environmental decision-making and management because attempts to promote participation in the PGEM created conflicts rather than cooperation (Kellert et al., 2000; Cooke and Kothari, 2001). The PGEM process exacerbated existing conflicts among fishers, and between fishers and hotels. It also created new conflicts between fishers, hotels, and lagoon tour operators over shark feeding. Finally, it instigated the rise of new fishers' and/or environmental associations in various communities around the island. In their inadequate attempts to invite public participation, the government ironically alienated stakeholders through the privileged use of GIS decision-making which was not accessible to the majority of Moorea's stakeholders. As a result, stakeholders eventually became willing to participate, although not in the ways that the government had hoped. Instead, they formed politicized and organized local associations which are not necessarily "for" the environment in the Western sense of environmentalism, but rather for their own livelihoods and sovereignty, and against government interference into lagoon management, commercial fishing and agriculture, and foreign exploitation of the lagoon.

Finally, incorporating public participation into environmental decision-making invites conflicts related to the "invention of tradition" (Hobsbawm and Ranger, 1983), as well as the invention of space and the environment (Goodwin, 1999). Especially in Moorea's lagoon where underwater resources and ecological processes are not sedentary, visible, or easily quantified, there was considerable debate between different stakeholders, the state, and scientists over indicators of lagoon health, patterns of fish reproduction and larval transport, the dynamics of land-based pollution effluents, and the location and importance of different lagoon uses and meanings. While the government and biologists cited "scientific" studies and spatial data to support the creation of the PGEM, Moorea's stakeholders likewise asserted their own knowledge of the lagoon by describing traditional lagoon management and fishing laws, reciting *Maohi* legends about Moorea and its lagoon, and explicating their life-long, daily interactions with the fish, coral reefs, sharks, and other organisms of Moorea's lagoon. Because the government would not incorporate diverse representations of the lagoon and its resources into the PGEM decision-making maps, stakeholders were compelled to insert their visions of sustainable lagoon management into the process in other ways. These included resisting the degradation of the lagoon by tourism development in an extended and very public protest action; making the PGEM a key issue in political elections; and fighting among themselves over access to lagoon resources.

## **Conclusion**

It is not my intention to argue that local control and public participation should not be strived for, or that Western science and GIS techniques should be abandoned in environmental decision-making. Rather, this study calls for a deeper exploration into the sometimes incongruous relationship between local control and Western notions of environmentalism. In addition, I am arguing for a closer analysis of how science is politically used and manipulated, and how it can be employed more democratically (see Benton, 1989; Taylor and Buttel, 1992; Latour and Woolgar, 1986). In this paper, I have attempted to illustrate why the degradation of Moorea's lagoon cannot be simply ascribed to the "tragedy of the commons," the obstinacy of

fishers in the face of science, or their lack of knowledge and appreciation for the lagoon environment and ecology. Instead, I suggest that environmental degradation and the role that local people play in it are products of the complicated histories of colonialism, militarism, and expanding capitalism in the region. The process of designating MPAs in Moorea would have been less contentious and more sustainable, perhaps, if state policy-makers had taken the time to understand what Guha calls “Third World environmentalism” (1997). This is an environmentalism in which the imperatives of making a livelihood must be reconciled with the pressures of modernization and local struggles for sovereignty and equity.

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### **References**

- Aberely D, Ed, 1993 *Boundaries of Home: Mapping for Local Empowerment* (New Society Publishers, Philadelphia, PA)
- Acheson, J, McCay B, 1987 *The Question of the Commons: The Culture and Ecology of Communal Resources* (University of Arizona Press, Tucson, AZ)
- Agardy T, 1997 *Marine Protected Areas and Ocean Conservation* (Academic Press, San Diego, CA)
- Agrawal A, 1995, “Dismantling the divide between indigenous and scientific knowledge” *Development and Change* **26** 413 - 39
- Aitken S, Michael S, 1995, “Who contrives the ‘real’ in GIS? Geographic information, planning and critical theory” *Cartography and Geographic Information Systems* **22** 17 - 29
- Appuhn K, 2000, “Inventing nature: forests, forestry, and state power in Renaissance Venice” *Journal of Modern History* **72(4)** 861 - 889
- ADPAEPF (Association pour la Développement et la Promotion des Actions Économiques de la Polynésie Française), 1989 *Investir à Tahiti et Dans Ses Îles* (Office of the President of French Polynesia, Papeete, Tahiti)
- Aubanel A, 1993 *Valeurs Socio-Économiques du Milieu Corallien Récifal et de ses Ressources*. unpublished PhD thesis, Ecole Pratique des Hautes Etudes, Moorea, French Polynesia.
- Bassett T, 1994, “Cartography and empire building in 19<sup>th</sup> century West Africa” *Geographical Review* **84(3)** 316 - 335

- Benton T, 1989. "Marxism and natural limits: an ecological critique and reconstruction," *New Left Review* **178** 51 - 86
- Berg L, and Kearns R, 1996, "Naming as norming: 'race', gender, and the identity politics of naming places in Aotearoa/New Zealand" *Environment and Planning D* **14(1)** 99 - 122
- Berkes F, 1999 *Sacred Ecology: Traditional Ecological Knowledge and Resource Management* (Taylor & Francis, Philadelphia, PA)
- Berkes F, Ed, 1989 *Common Property Resources: Ecology and Community-Based Sustainable Development* (Belhaven Press, New York, NY)
- Blaikie P, Brookfield H, 1987 *Land Degradation and Society* (Methuen, London, New York)
- Blanchet G, 1985 *L'économie de la Polynésie française de 1960 à 1980* (ORSTOM, Paris)
- Bojorquez-Tapia L, Diaz-Mondragon S, Ezcurra E, 2001, "GIS-based approach for participatory decision making and land suitability assessment" *International Journal of Geographical Information Science* **15(2)** 129 - 151
- Brokensha D, Warren D, and Werner O, 1980 *Indigenous Knowledge Systems and Development* (University Press of America, Washington DC)
- Bryant R, Bailey S, 1997 *Third World Political Ecology* (Routledge, London, New York)
- Budd-Falen K, 1995, "Protecting community stability and local economies: opportunities for local government influence in federal decision- and policy-making processes" in *A Wolf in the Garden* Eds P Brick, R Cawley (Rowman & Littlefield, Lanham, MD) pp 73 - 86
- Buisseret D, Ed, 1992 *Monarchs, Ministers, and Maps: The Emergence of Cartography as a Tool of Government in Early Modern Europe* (University of Chicago Press, Chicago)
- CDFG (California Department of Fish and Game), NOAA's CINMS (Channel Islands National Marine Sanctuary), 2001 *A Recommendation for Marine Protected Areas in the Channel Islands National Marine Sanctuary* (CDFG and CINMS, Santa Barbara, CA)
- Carney J, Watts M, 1990, "Manufacturing dissent: work, gender, and the politics of meaning in a peasant society" *Africa* **60(2)** 207 - 241
- CDPESC (Charte du Développement pour le Progrès Économique, Social, et Culturel de la Polynésie Française), 1995 *Main Statistics of French Polynesia and Main Economic Goals of the Pact de Progres*. Charte du Développement pour le Progrès Économique, Social, et Culturel de la Polynésie Française, Papeete, Tahiti)
- Clark M, 1998, "GIS – democracy or delusion?" *Environment and Planning A* **30(2)** 303 - 316
- Cooke B, Kothari U, Eds, 2001 *Participation: the new tyranny?* New York: Zed Books.
- Craib R, 2000, "Cartography and power in the conquest and creation of new Spain" *Latin American Research Review* **35(1)** 7 - 36
- Craig W, Elwood S, 1998, "How and why community groups use maps and geographic information" *Cartography and Geographic Information Systems* **25** 95 - 104

- Craig W, Harris T, Weiner D, 1998 *Empowerment, Marginalization and Public Participation GIS: Report of Varenius Workshop* (National Center for Geographic Information and Analysis, Santa Barbara, CA)
- Croll E, Parkin D, Eds, 1992 *Bush Base, Forest Farm: Culture, Environment, and Development* (Routledge, London, New York)
- Cultural Survival Quarterly, 1996 *Who's Local Here? The Politics of Participation in Development* **20(3)**
- Curry M, 1998 *Digital Places: Living with Geographic Information Technologies* (Routledge, London, New York)
- Curry M, 1994, "Images, practice, and the hidden impacts of GIS" *Progress in Human Geography* **18** 441 - 59
- de Lopez T, 2001, "Stakeholder management for conservation projects: A case study of Ream National Park, Cambodia" *Environmental Management* **28(1)** 47 - 60
- Dixon D, Jones J, 1998, "My dinner with Derrida, or spatial analysis and post-structuralism do lunch" *Environment and Planning A* **30(2)** 247 - 260
- Dorling D, 1998, "Human cartography: when it is good to map" *Environment and Planning A* **30(2)** 277 - 288
- Dufour V, Galzin R, 1993, "Colonization patterns of reef fish larvae to the lagoon at Moorea Island, French Polynesia" *Marine Ecology Progress Series* **102(1-2)** 143 - 152
- Durrenberger E, 1990, "Policy, power, and science" *Maritime Anthropological Studies* **3** 69 - 86
- Dyer C, McGoodwin J, Eds, 1994 *Folk Management in the World's Fisheries* (University Press of Colorado, Boulder)
- Elliott G, Mitchell B, Wiltshire B, Manan I, Wismer S, 2001, "Community participation in marine protected area management: Wakatobi National Park, Sulawesi, Indonesia" *Coastal Management* **29(4)** 295 - 316
- Escobar A, 1995 *Encountering Development* (Princeton University Press, Princeton, NJ)
- Escobar M, 1997, "Exploration, cartography and the modernization of state power" *International Social Science Journal* **49(1)** 55 - 68
- Feeny D, Berkes F, McCay B, Acheson J, 1990, "The tragedy of the commons: twenty-two years later" *Human Ecology* **18(1)** 1 - 19
- Fischer F, 2000 *Citizens, Experts, and the Environment* (Duke University Press, Durham, NC)
- Gabrie C, Galzin R, Salvat B, 1988 *Activites Humaines et Recifs Corailien – Moorea* (Museum National d'Histoire Naturelle, Moorea, French Polynesia)
- Golledge R, Couclelis H, Gould P, Eds, 1988 *A Ground for Common Search* (Santa Barbara Geographical Press, Goleta, CA)
- Goodwin P, 1999, "The end of consensus? the impact of participatory initiatives on conceptions of conservation and the countryside in the United Kingdom" *Environment and Planning D* **17(3)** 383 - 401

- Goss J, 1995, "Marketing the new marketing: the strategic discourse of geodemographic information systems", in *Ground Truth: The Social Implications of GIS* Ed J Pickles (Guilford Press, New York)
- Gregory D, 1994 *Geographical Imaginations* (Blackwell Publishers, Cambridge)
- Grimble R, Wellard K, 1997, "Stakeholder methodologies in natural resource management: A review of principles, contexts, experiences and opportunities" *Agricultural Systems* **55(2)** 173 - 193
- Guha R, 1997, "The environmentalism of the poor", in *Between Resistance and Revolution: Cultural Politics and Social Protest* Eds R Fox, O Starn (Rutgers University Press, New Brunswick, NJ)
- Halpern B, forthcoming, "The impact of marine reserves: do reserves work and does reserve size matter?" *Ecological Applications* in press
- Hardin G, 1968, "The tragedy of the commons" *Science* **162** 1243 - 48
- Harley J, 1988, "Maps, knowledge, and power", in *The Iconography of Landscape* Eds D Cosgrove, S Daniels (Cambridge University Press, Cambridge)
- Henningham S, 1992 *France and the South Pacific: A Contemporary History* (University of Hawaii Press, Honolulu, HI)
- Hobsbawm E, Ranger T, 1983 *The Invention of Tradition* (Cambridge University Press, Cambridge)
- Homer-Dixon T, 1994, "Environmental scarcities and violent conflict – evidence from cases" *International Security* **19(1)** 5 - 40
- Hunter C, Green H, 1995 *Tourism and the Environment: A Sustainable Relationship?* (Routledge, London)
- ITSTAT (Institut Territorial de la Statistique), 2000 *Les Tableaux de l'Economie Polynésienne* (ITSTAT, Papeete, Tahiti)
- ITSTAT, 1998 Te A Vei'a Iti, Bulletin d'Informations Statistiques (ITSTAT, Papeete, Tahiti)
- Jankowski P, Nyerges T, 2001 *Geographic Information Systems for Group Decision Making* (Taylor & Francis, New York)
- Jentoft S, 1999, "Healthy fishing communities: an important component of fish stocks" *Fisheries* **24** 28 - 29
- Johannes R, 1994, "Pacific island peoples' science and marine resource management", in *Science of the Pacific Island Peoples* Ed J Morrison (Institute of Pacific Studies, University of the South Pacific, Suva, Fiji)
- Kain R, Baigent E, 1992 *The Cadastral Map in the Service of the State: a History of Property Mapping* (University of Chicago Press, Chicago)
- Kelleher G, Bleakley C, Wells S, Eds, 1995 *A Global Representative System of Marine Protected Areas* (World Bank, Washington, DC; IUCN, Gland, Switzerland)

- Kellert S, Mehta J, Ebbin S, Litchfield L, 2000, "Community natural resource management: promise, rhetoric, and reality" *Society and Natural Resources* **13(3)** 705 - 715
- Lake R, 1993, "Planning and applied geography: positivism, ethics, and GIS" *Progress in Human Geography* **17** 404 - 13
- Latour B, Woolgar S, 1986 *Laboratory Life: The Construction of Scientific Facts* (Princeton University Press, Princeton, NJ)
- Lencek L, 1998 *The Beach: The History of Paradise on Earth* (Viking, New York, NY)
- Living Oceans Society, 2001 *Proceedings of the Marine Protected Areas (MPAS) Power Tools Conference* White Rock, BC, October 19-21, 2001 (Living Oceans Society, Sointula, BC)
- Malczewski J, 1999 *GIS and Multicriteria Decision Analysis* (J. Wiley & Sons, New York, NY)
- McGuire M, 1998, "A political ecology of fisheries", in *Reinventing Fisheries Management* Eds T Pitcher, P Hart (Kluwer Academic Publishers, London)
- Mikalsen K, Jentoft S, 2001, "From user-groups to stakeholders? The public interest in fisheries management" *Marine Policy* **25(4)** 281 - 292
- Monmonier M, 1991 *How to Lie with Maps* (University of Chicago Press, Chicago)
- Moore D, 1998, "Subaltern struggles and the politics of place: remapping resistance in Zimbabwe's eastern highlands" *Cultural Anthropology* **13(3)** 344 - 381
- MSRDS (Ministère de la Santé et de la Recherche Direction de la Santé), 1999 *Qualité Bacteriologique des Eaux de Baignade à Tahiti, Moorea, Bora Bora, Raiatea, et Huahine, Année 1998* (Service d'Hygiène et de Salubrité Publique, Papeete, Tahiti)
- Neumann R, 1996, "Dukes, earls, and ersatz Edens: aristocratic nature preservationists in colonial Africa" *Environment and Planning D* **14(1)** 79 - 98
- Nichols K, 1995, "Between a coral reef and a hard place: the politics of coastal management in Sri Lanka" *Middle States Geographer* **28** 45 - 52
- Nietschmann B, 1995, "Defending the Miskito reefs with maps and GPS" *Cultural Survival* **18** 34 - 37
- Nobles G, 1993, "Straight lines and stability: mapping the political order of the anglo-American frontier" *The Journal of American History* **80(1)** 9 - 35
- Obermeyer N, 1995, "The Hidden GIS Technocracy" *Cartography and Geographic Information Systems* **22(1)** 78 - 83
- Oliver D, 1974 *Ancient Tahitian Society*, v 3 (University of Hawaii Press, Honolulu, HI)
- O'Looney J, 1997 *Beyond Maps: GIS and decision making in local government* (ICMA, Washington, DC)
- Openshaw S, 1991, "Commentary: a view on the GIS crisis in geography, or, using GIS to put Humpty-Dumpty back together again" *Environment and Planning A* **23(4)** 621 - 628
- Osman W, 1996 *French Polynesia Economic Report* (Bank of Hawaii, Honolulu, HI)

- Ostrom E, 1995, "Design complexity to govern complexity", in *Property Rights and the Environment: Social and Ecological Issues* Eds, S Hanna, M Munasinghe (World Bank, Washington DC) pp 33 - 46
- Ostrom E, 1990 *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press, Cambridge)
- Ostrom E, 1986, "An agenda for the study of institutions" *Public Choice* **48(1)** 3 - 25
- Ostrom E, Burger J, Field C, Norgaard R, Policansky D, 1999, "Revisiting the commons: local lessons, global challenges" *Science* **284(5412)** 278 - 282
- PATA (Pacific Asia Travel Association), 1991 *Moorea and Tourism: Managing the Balance Between Development and Conservation* (PATA Pacific Division, King Cross, Australia)
- Peet R, Watts M, 1996 *Liberation Ecologies: Environment, Development, Social Movements* (Routledge, London)
- Peluso N, 1995, "Whose woods are these? counter-mapping forest territories in Kalimantan, Indonesia" *Antipode* **27(4)** 383 - 406
- Peluso N, 1992 *Rich Forests, Poor People: Resource Control and Resistance in Java* (University of California Press, Berkeley, CA)
- Peluso N, Watts M, 2001 *Violent Environments* (Cornell University Press, Ithaca, NY)
- Pickles J, Ed, 1995 *Ground Truth: The Social Implications of GIS* (Guilford Press, New York)
- Pickles J, 1991, "Geography, GIS, and the surveillant society" *Papers and Proceedings of Applied Geography Conferences* **14** 80 - 91
- Planes S, Levefre A, Legendre P, Galzin R, 1993, "Spatio-temporal variability in fish recruitment to a coral reef (Moorea, French Polynesia)" *Coral Reefs* **12(2)** 105 - 113
- Porcher M, Gabrie C, 1987 *Schéma Général d'Exploitation de Granulats et Protection de l'Environnement de Moorea et des Îles Sous le Vent: Les Extractions en Milieu Corallien* (Antenne Museum, Papeete, Tahiti)
- Rangan H, 1996, "From Chipko to Uttaranchal", in *Liberation Ecologies* Eds R Peet, M Watts (Routledge, London)
- Robineau C, 1984 *Du Coprah à l'Atome* (OSTROM, Paris)
- Rundstrom R, 1995, "GIS, indigenous peoples, and epistemological diversity" *Cartography and Geographic Information Systems* **22** 45 - 57
- Sachs W, 1993, "Global ecology and the shadow of development", in *Global Ecology: A New Arena of Political Conflict* Ed W Sachs (Zed Books, London) pp 3 - 21
- Salm R, Clark J, Siirila E, 2000 *Marine and Coastal Protected Areas: a Guide for Planners and Managers* (International Union for Conservation of Nature and Natural Resources, Gland, Switzerland)
- Schuurman N, 2000, "Trouble in the heartland: GIS and its Critics in the 1990s" *Progress in Human Geography* **24(4)** 569 - 590.

- Sheppard E, Ed, 1995, "Special Issue: GIS and Society," *Cartography and GIS* 22
- Shiva V, 1989 *Staying Alive* (Zed Press, London)
- Sieber R, 2000a, "GIS implementation in the grassroots" *Urban and Regional Information Systems Association Journal* **12(1)** 15 - 29
- Sieber R, 2000b, "Conforming (to) the opposition: the social construction of geographical information systems in social movements" *International Journal of Geographical Information Science* **14(8)** 775 - 793
- Smith N, 1992, "Real wars, theory wars" *Progress in Human Geography* **16** 257 - 71
- Stanbury K, Starr R, 1999, "Applications of Geographic Information Systems (GIS) to habitat assessment and marine resource management" *Oceanologica Acta* **22(6)** 699 - 703
- Steinberg P, 2001 *The Social Construction of the Ocean* (Cambridge University Press, Cambridge)
- Stonich S, 1995 "The environmental quality and social justice implications of shrimp mariculture in Honduras" *Human Ecology* **23** 143 - 168
- Stonich S, 1998, "Political ecology of tourism" *Annals of Tourism Research* **25(1)** 25 - 54
- Stonich S, Bailey C, 2000, "Resisting the blue revolution: contending coalitions surrounding industrial shrimp farming" *Human Organization* **59(1)** 23 - 36
- STT (Service Territorial du Tourisme), 2001 *Frequentations Touristiques 2000* (Ministère du Tourisme et de l'Environnement, Papeete, Tahiti).
- Suman D, Shivlani M, Milon J, 1999, "Perceptions and attitude regarding marine reserves: a comparison of stakeholder groups in the Florida Keys National Marine Sanctuary" *Ocean and Coastal Management* **B** 1019 - 1040
- Taylor P, Buttel F, 1992, "How do we know we have global environmental problems? science and the globalization of environmental discourse" *Geoforum* **23(3)** 405 - 16
- Thompson V, Adloff R, 1971 *The French Pacific Islands: French Polynesia and New Caledonia* (University of California Press, Berkeley, CA)
- Towers G, 1997, "GIS versus the community: siting power in southern West Virginia" *Applied Geography* **17(2)** 111 - 125
- Trist C, 1999, "Recreating ocean space: recreational consumption and representation of the Caribbean marine environment" *The Professional Geographer* **51(3)** 376 - 387
- Vallega A, 2001 *Sustainable Ocean Governance: A Geographical Perspective* (Routledge, London)
- Vayda A, Walters B, 1999, "Against political ecology" *Human Ecology* **27(1)** 167 - 179
- Walker B, 2001, "Sisterhood and seine-nets: engendering development and conservation in Ghana's marine fishery" *The Professional Geographer* **53(2)** 160 - 177
- Warf B, 2001, "Segueways into cyberspace: multiple geographies of the digital divide" *Environment and Planning B* **28(1)** 3 - 19

- Wells M, Brandon K, 1992 *People and Parks: Linking Protected Area Management with Local Communities* (World Bank / World Wildlife Fund / USAID, Washington DC)
- West P, Brechin S, 1991, *Resident Peoples and National Parks: Social Dilemmas and Strategies in International Conservation* (University of Arizona Press, Tucson)
- Western D, Wright R, Eds, 1994 *Natural Connections: Perspectives in Community-Based Conservation* (Island Press, Washington DC)
- Wood D, 1992 *The Power of Maps* (Guilford Press, New York)
- Young E, 2001, "State intervention and abuse of the commons: Fisheries development in Baja California" *The Annals of the Association of American Geographers* **91(2)** 283 – 306
- Young E, 1999, "Balancing conservation with development in small-scale fisheries: is ecotourism an empty promise?" *Human Ecology* **27(4)** 581-620